REMARKS/ARGUMENTS

Applicants request that the examiner consider the following remarks upon further review of the instant application.

Interview Summary

The undersigned attorney for Applicants conducted a telephone interview with Examiner Daniel J. Petkovsek and SPE John D. Lee on 22 June 2005.

Claim Rejections for Anticipation or Obviousness – 35 U.S.C. §§ 102(e) & 103(a)

As before, claims 1, 2, 5, 6, 9, 10, 13, 14, 16-18, and 20-25 are rejected as either anticipated by, or in the alternative, obvious in view of U.S. patent application publication no. 2003/0107927 A1 of Yerushalmi et al. (the '927 publication). The arguments presented by the examiner in the final Office action are identical to the arguments presented in the prior Office action dated 22 April 2005. As before, Applicants contend the rejections based upon the '927 publication are moot because the portions of the '927 publication used as a basis for the rejections are not entitled to an earlier priority date than the application filing date of the '927 publication.

The '927 publication is cited as prior art pursuant to 35 U.S.C. § 102(e). This means that the '927 publication was published after the filing date of Applicants' application. However, the '927 publication ostensibly may be accorded an earlier priority date than Applicants' priority date due to either an earlier application filing date, a priority claim, or both. The application filing date of the '927 publication is 31 July 2002. The '927 publication is designated as a continuation-in-part of and claims priority to Patent Cooperation Treaty (PCT) application no. PCT/US2002/07178 (the '178 application) filed 12 March 2002. 35 U.S.C. § 120; 37 C.F.R. § 1.53(b)(2). The '178 application was filed and published in English and therefore is accorded an effective date of 12 March 2002. 35 U.S.C. § 102(e) The '178 application claims priority to U.S. provisional patent application no. 60/274,635 (the '635 application) filed on 12 March 2001 pursuant to 35 U.S.C. § 119(e). Therefore, the '927 publication could be accorded effective dates as early as 12 March 2002 based upon the '178 application pursuant to 35 U.S.C. § 119(a), or 12 March 2001 based upon the '635 application pursuant to 35 U.S.C. § 119(e).

Applicants' application has a filing date of 26 September 2001 and a priority date of 14 August 2001 based upon U.S. provisional application 60/312,264 (the '264 application). Therefore, at least facially, the '927 publication could be accorded an effective date earlier than

Applicants' priority date based upon the '635 application, but not the '178 application because its filing date is later than both Applicants' filing date and priority date. However, a 35 U.S.C. § 102(e) reference relying on a priority claim to support an earlier effective date is only effective as an anticipatory reference to the extent that the priority application upon which the effective date is based also discloses the subject matter upon which the rejections in the Office action are based. "The 35 U.S.C. § 102(e) critical reference date of a ... U.S. application publication ... entitled to the benefit of the filing date of a provisional application under 35 U.S.C. § 119(e) is the filing date of the provisional application ... **if** the provisional application properly supports the subject matter relied upon to make the rejection in compliance with 35 U.S.C. § 112, first paragraph." M.P.E.P. §2136.03(III) (emphasis in original). "The subject matter used in the rejection <u>must be disclosed</u> in the earlier-filed application in compliance with 35 U.S.C. § 112, first paragraph in order for that subject matter to be entitled to the earlier filing date under 35 U.S.C. § 102(e)." M.P.E.P. § 706.02(f)(1)(I)(C)(1) (emphasis added); <u>see</u> <u>also</u> M.P.E.P. § 706.02(f)(1)(II), Example 7. During the interview, both Examiner Petkovsek and Examiner Lee agreed that in order to support a rejection based upon the '927 publication, subject matter meeting each of the limitations of the claims pending in the present application must be found in the priority document, i.e., in the '635 application.

In this case, the '927 publication is not an effective 35 U.S.C. § 102(e) reference because the '635 application, i.e., the priority document upon which the effective date of the '927 publication is based, does not disclose the subject matter forming the basis for the rejection. As noted above, the '927 publication is a continuation-in-part application, which by definition means that it includes new subject matter beyond that previously disclosed in any priority document. 37 C.F.R. § 1.53(b). None of the subject matter described in the text, e.g., paragraphs [0264]-[0337] and specifically paragraphs [0276]-[0279] and [0334], or drawing figures, e.g., Figs. 11, 14, and 15, of the '927 publication used to support the rejections is found in the '635 application. Although ultimately inconsequential to this analysis, this subject matter is also not found in the '178 application. In fact, the first time this subject matter appears is in the '927 publication only. Applicants can find no disclosure in the '635 application meeting the requirements of 35 U.S.C. § 112 comparable to the disclosure in the '927 publication that forms the basis of the rejections.

Thus, the rejections of and objections to the claims are unfounded because the disclosure of the '927 publication used in support of the rejections is not entitled to an earlier effective date than the present application. The subject matter added to the '927 publication, upon which the rejections are solely based, may only be accorded only an effective date of 31 July 2002, the filing date of its corresponding U.S. application. Thus, both Applicants' 14 August 2001 priority date and 26 September 2001 nonprovisional filing date are entitled to priority over the '927 publication.

Because the '927 publication, which forms the basis for all rejections, cannot be considered an effective prior art reference, Applicants request that the rejections of claims 1, 2, 5, 6, 9, 10, 13, 14, 16-18, and 20-25 and the objections to claims 3, 4, 11, 12, 15, and 19 be withdrawn.

Response to "Response to Arguments" in Detailed Action

Paragraph 5 of the detailed action finds the arguments presented in Applicants 12 May 2005 Response "not persuasive." This statement defies credulity. The arguments previously presented and restated above are a recitation of the law, specifically 35 U.S.C. §102(e), as applied to the present factual scenario when the filing dates of the cited references are compared to the present application. The documents speak for themselves and the law is clear. Together, the only possible conclusion is that the '927 publication is not an effective prior art reference and cannot support the rejections made.

Paragraph 6 of the detailed action, which Applicants presume is an attempt to define a quantum dot, states that "a quantum dot has been described [in the art] as 'a small piece of a substance having a small size in all three dimensions.' A quantum dot has only a few discrete states in which it can exist, for example, having one or zero extra electrons, having an excess spin up or down, having its magnetization vector point up or down, or having an electron in its first, second, or higher excited state. A quantum dot can be stabilized by gating, optical excitation, or other control devices." First, there is no identification of any reference, much less a reference previously or contemporaneously cited in the file history of the present application, from which this definition is derived, including a portion that is presented as a direct quotation. During the interview of 22 June 2005, Applicants were informed that this quantum dot description was taken from U.S. Patent No. 5,530,263 to DiVincenzo (the '263 patent). The '263 patent has not been cited as a reference in the file history of the instant application.

Second, this purported quantum dot definition is both incomplete and inaccurate. In the paraphrased passage in the Office action, the quoted portion actually omits several parenthetical elements that are significant to the definition of a quantum dot device. The actual sentence reads, "A quantum dot is a small piece of a substance (commonly a semiconductor such as Si or GaAs, but possibly also a metal, magnet or antiferromagnetic) having a small size (typically between 1 nm and 10 nm) in all three dimensions." Col. 1, ll. 64-67. Even with the addition of the omitted language, however, the '263 patent itself still provides an incomplete quantum dot description and makes several inaccurate statements about the nature of quantum dots.

The '263 patent describes the size and composition of a semiconductor quantum dot device, but does not describe the all-important trait of a quantum dot—quantum confinement of charge carriers—or explain how quantum confinement is achieved (e.g., with an insulative barrier or an electric field). Instead, the '263 patent states that a quantum dot is "distinguished functionally by having only a few discrete states in which it can exist, for example, having one or zero extra electrons…." Col. 2, ll. 5-7. This is neither true, nor explanatory of what a quantum dot is or does. For example, quantum dots have been built which can hold anywhere from zero to hundreds of electrons at a variety of energy levels, resulting in a combinatorially huge number of states. Comparatively, a nanoscale mechanical switch, which is clearly not a quantum device, has only two states and thus meets the purported definition of a "quantum dot" in the '263 patent. This suggestion of equation of a mechanical switch and quantum dot is simply incorrect.

A much better definition of a quantum dot is found in U.S. application publication no. 2002/0114367 (the '367 publication), which is a reference of record in the present application. A quantum dot is described in the '367 publication as "a three-dimensional quantum-confined heterostructure which confines electrons and holes [charge carriers] in a region having a size, along each of the three dimensions, that is less than the thermal de Broglie wavelength [of the charge carriers] at room temperature (i.e., less than 100 nanometers in many applications.) The quantum confinement produces quantum confined energy states within each dot for electrons and holes. There are also corresponding optical transition energies for both electrons and holes associated with a ground state transition energy, first excited state transition energy, second excited state transition energy, etc." See ¶ [00007].

Another definition for a quantum dot presented by some of the foremost researchers in the field is stated as follows:

> "Typically, quantum dots are small regions defined in a semiconductor material with a size of order 100 nm. … The name "dot" suggests an exceedingly small region of space. A semiconductor quantum dot, however, is made out of roughly a million atoms with an equivalent number of electrons. Virtually all electrons are tightly bound to the nuclei of the material, however, and the number of free electrons in the dot can be very small; between one and a few hundred. The de Broglie wavelength of these electrons is comparable to the size of the dot, and the electrons occupy discrete quantum levels (akin to atomic orbitals in atoms) and have a discrete excitation spectrum. A quantum dot has another characteristic, usually called the charging energy, which is analogous to the ionization energy of an atom. This is the energy required to add or remove a single electron from the dot. Because of the analogies to real atoms, quantum dots are sometimes referred to as artificial atoms. The atom-like physics of dots is studied not via their interaction with light, however, but instead by measuring their transport properties, that is, by their ability to carry an electric current. Quantum dots are therefore artificial atoms with the intriguing possibility of attaching current and voltage leads to probe their atomic states."

L.P. Kouwenhoven et al., "Electron transport in quantum dots," Advanced Study Institute on Mesoscopic Electron Transport, (L.L. Sohn, L.P. Kouwenhoven, G. Schön eds.) (Kluwer 1997) p. 2; (references omitted). Consistent between these two definitions is the concept of confinement of electrons in a small region of space, comparable to the de Broglie wavelength of the electrons. While the electrons confined in the quantum dot do not orbit a nucleus, they do arrange in energy levels similar to orbitals or valence levels in atoms and are thus referred to as artificial atoms. None of these important attributes are described in the '263 patent.

The structures described in the '263 patent further render its purported definition of a quantum dot suspect. The description of the center dot is extremely vague; no real antiferromagnetic material is listed as an example, and the number of electrons trapped in the dot, or the means used to confine them (e.g., an insulative barrier), is not specified. Since the overlap between the dots can be "several hundred or so squared-nm's" [sic], col. 2, ll. 41-42, the center dot is presumably much larger than 100 nm in diameter. However, no dimensions or range of operating temperatures are listed for structures, even though these are critical to the functioning of a quantum dot. Furthermore, the '263 patent states that the antiferromagnetic dots are electrically insulating, rather than conductive or semiconductive. This implies that there are no conduction electrons in the material, hence no quantum confinement. Thus, by the structural description in the '263 patent, the antiferromagnetic device is not a quantum dot at all, but merely a nanoscale bit or flip-flop. Further, if three quantum dots physically overlap (as

described in the '263 patent), with no barriers between them, then by definition they would form a single quantum dot, albeit of strange shape.

Paragraph 7 of the Detailed Action describes the disclosure in the '927 publication of a "molecular engine" used to perform work at the "*molecular level*, alter mechanically the conformation of a substrate molecule or any other manipulation at the *molecular level*" (emphasis in Office action). The Office action appears to place significance on the concept of "molecular level" activity of the molecular engine structures and then proceeds to equate a "molecular level" with a "quantum mechanical level." This equation is mistaken. By definition, molecules are composed of a plurality of atoms chemically bonded together. Alternatively, quantum mechanics involves the behavior of sub-atomic particles (e.g., electrons, positrons, and smaller) and the duality of their wave properties. Quantum dots are generally crystalline atom structures or areas bounded by electric potentials in which otherwise free charge carriers are confined in such a small area (the Bohr radius) that the charge carriers exhibit wave properties (their de Broglie wavelength). While quantum mechanics ultimately plays a role in the explanation of chemical reactions, to suggest that a "molecular level" is the same as a "quantum mechanical level" is simply inaccurate.

The term "quantum mechanical" is used in the '635 application in a few instances to describe calculation methods (see pp. 7 and 12). These uses are not, however, in reference to electrons confined in quantum dots, but rather to mathematical determinations of force constants for the spring properties of the molecular engine, or of the ordinary migration of electrons between atomic and molecular orbitals, which occurs in all chemistry. This electron orbital change is the result of the photoexcitation effect of a central chelated Ni atom in an axial ligand configuration described in the '635 application (see p. 18). Again, the discussion concerns excitation of electrons in orbitals around the Ni nucleus, not the confinement of electrons dissociated from any particular atom within a potential well. The remainder of the '635 application discusses detailed chemistry but makes no further reference to quantum mechanics. There is no discussion of quantum confinement of electrons or other charge carriers, which is the *sine qua non* of a quantum dot, in the '635 application at all. The Office action further purports that the '635 application "teaches applications of the molecular engine ... with a quantum dot." This statement is facially inaccurate. Nowhere in the '635 application is the concept of a quantum dot ever mentioned or described.

Paragraph 8 states that "Applicant's [sic] vague traversal leaves the examiner unsure as to what Applicant [sic] feels is missing in the '635 application." First, there was no discussion of the '635 application in the 22 April 2005 Office action and no explication of any foundation or support for the rejections found in the '635 application. Second, it is not Applicants' obligation or burden to prove a negative, i.e., point out with any further particularity how the '635 application did not include anticipatory subject matter (if that is even possible), especially when the Office had not met its prima facie burden.

Paragraph 9 states that the '635 application supports the rejections made in the 22 April 2005 Office action. When asserting an anticipation rejection, the Office has a prima facie burden to provide an enabling, "prior art" disclosure. M.P.E.P. §§ 2101 & 2101.01. As discussed previously and above, the '927 publication does not meet the definition of effective prior art. Again, the final Office action was the first time the examiner provided discussed any aspect of the '635 application. Therefore, the Office failed to meet its prima facie burden in the prior, non-final Office action. Second, as discussed above, the '635 application does not in fact support the subject matter of the '927 publication used as the basis for rejection of the claims.

Paragraph 9 further states that Applicants did not discuss the merits of the rejections in the 22 April 2005 Office action in their 12 May 2005 response. During the interview, the examiners again asserted that Applicants' response to the 22 April 2005 Office action was not fully responsive because Applicants did not specifically respond to the "substantive" rejections based upon the '927 publication. However, Applicants had and still have no obligation to make any response to these "substantive" rejections because the disclosure relied upon in the '927 publication is not effective prior art. As discussed above, the disclosure of the '635 application does not provide a prior enabling description of the subject matter in the '927 application used to make the rejections.

Even with its added discussion of the '635 application, the final Office action still fails to meet the prima facie burden for anticipation because it fails to base any rejections to the claims upon any disclosure actually found in the '635 application. Applicants continue to contend that rejections cannot be supported by the '635 application. This becomes apparent when attempting to find any disclosure in the '635 application that anticipates any of the elements of the two pending independent claims because there is none. Claim 1 states:

We claim a device for producing quantum effects, comprising:

a material fashioned into an elongated fiber shape;

one or more control paths which carry energy along said material;

a plurality of quantum dots, physically connected with said material and energetically connected to said control paths; wherein

the energy carried in said control paths actuate the quantum dots to trap and hold a controlled configuration of charge carriers, thus forming artificial atoms whose size, shape, atomic number, and/or energy level are dependent on the energies in said control paths.

(Underlining added.) Claim 20 states:

We claim a device for producing quantum effects, the device comprising:

a material fashioned into an elongated fiber shape;

a plurality of quantum dots, physically connected with said material;

at least one control path physically connected with said material and operatively coupled with said plurality of quantum dots, wherein said at least one control path is adapted to carry energy from an energy source to said plurality of quantum dots; and

a plurality of charge carriers capable of being confined within said plurality of quantum dots to form a respective plurality of artificial atoms;

wherein said energy is adapted to stimulate each quantum dot of said plurality of quantum dots to thereby confine a respective subset of said plurality of charge carriers within each said quantum dot to form a respective one of said plurality of artificial atoms;

wherein said energy determines the size, shape, atomic number, and/or energy level of each artificial atom of said respective plurality of artificial atoms confined in each respective quantum dot; and

wherein said plurality of artificial atoms alter the electrical, optical, thermal, magnetic, mechanical, and/or chemical properties of said material.

(Underlining added.)

The '635 application contains no occurrences of the following terms: "quantum dot," "confine," "confinement," "charge carriers," "control path," "conduit" (or other particular

structure, e.g., wires), or "artificial atom." Further, there is no alternate terminology of description in the '635 application of any structure or device remotely close to these primary and significant elements in Applicants' claims. Thus, the '635 application cannot be construed to anticipate or render obvious the claims of the present application because it does not teach every element of the claims. M.P.E.P. § 2131.

In addition to not disclosing these specific elements of the claims, as a general matter there is no discussion in the '635 application of using the "molecular engine" as a dopant to alter the properties (e.g., electrical, optical, thermal, magnetic, mechanical, and/or chemical) of materials. While the Office action suggests equivalence between a molecular engine and a quantum dot, the fact is that the function and effects of a molecular engine are entirely different than the function and effects of a quantum dot. Again, the '635 application fails to teach any of the elements of the claims. M.P.E.P. § 2131. The term "dopant" is never used, nor are there any references to "de Broglie wavelength" or "Bohr radius," which are two physical properties essential to the nature of, and any discussion of, a quantum dot.

A "molecular engine" is described in the '635 application as "a molecular module that has the ability to store energy of a particular molecular conformation in certain chemical bonds and convert it into motion" (see p. 1), i.e., converting chemical energy into mechanical energy. Control is provided by breaking and forming chemical bonds, releasing and storing potential energy, and converting that energy into movement. However, there is no description of any control path, conduit, wire, or similar energy transfer structure connected to a molecular engine and no description of supplying energy to the molecular engine through such a structure. As described, the molecular engine is capable of storing energy only in the form of chemical bonds, its entire purpose is to turn energy into motion and vice-versa, either for mechanical purposes or to actuate an electrical or optical switch. On page 4, the '635 application mentions activation of the molecular engine by reduction or oxidation reactions, which may generate electric current. This current is a by-product of electro-chemical reactions (see p. 10) that are only described as occurring in solution. Again, wires and other energy carrying conduits or control paths are not mentioned or implied as part of the molecular engine structure. A "capability of coupling to the outside world" is mentioned (see p. 1), but never elaborated.

There is discussion in the '635 application of embedding the device in a photoactive material, but only as a switch (see pp. 6-7), not as a dopant to alter the material's properties.

There is no discussion of constructing bulk materials from a plurality of devices. Controlled changes in the molecular engine's optical response (i.e., color) via photoexcitation are also discussed, but only when the molecules are suspended in a solvent. Such photochromic reactions are common in chemistry and are not the result of a doping effect within a bulk material. Other than mechanical (i.e., spring) properties of the molecular engine, no other properties of the molecular engine or any other material are described as changing under these circumstances. Therefore, based upon both the specific absence of the primary and most significant elements of Applicants' claims and the entirely different subject matter of the disclosure in general, it is clear that the '635 application does not disclose anticipatory subject matter to the claims of the present application.

Conclusion

For the reasons set forth above, Applicants respectfully request that the rejections of claims 1, 2, 5, 6, 9, 10, 13, 14, 16-18, and 20-25 and the objections to claims 3, 4, 11, 12, 15, and 19 be withdrawn and a new Notice of Allowance be swiftly issued in this case. Applicants further request that the issue fee previously paid by Applicants be applied to any new request for payment of an issue fee. Applicants further request that the issuance of a patent on these claims be expedited due to the improper withdrawal of the application from issue by the Office and the delay in issuance caused thereby.

Respectfully submitted this 13th day of July 2005.

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